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THE BLOOD IN MEASLES.*

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LITERATURE.

THE literature on the blood in measles is not extensive. The earlier reports relate chiefly to the enumeration of the white and red cells, and to the estimation of the hemaglobin, and it is only in recent years that thorough studies have been made by Türk, Reckzeh, and others.

The first observations date back to 1887, when Widowitz, estimating the hemaglobin in various diseases, found in eighteen cases of measles a moderate decrease at defervescence, followed by an increase during convalescence. Hayem (1889) recorded 10,000 and 14,000 white cells in two cases, the second complicated by angina. The red cells were only slightly reduced, seldom as many as 500,000. Pée (1890) examined five cases by a rather unreliable method. In four he found normal or diminished leucocytes; in the fifth, a count of 15,000, which he attributed to the puerperium. He found the large mononuclear cells increased. Pick (in the same year) reported one case with no leucocytes.

Rieder (1892) studied the blood in eight cases, finding normal and subnormal counts, the lowest 2,700. In one apparently uncomplicated case he found 15,000 on the fourth day of the rash, in a three-year-old child. A complication by bronchopneumonia showed 15,500. Rieder was the first to call attention to the possible value of the lack of leucocytes in differentiating between measles and scarlatina.

Rille (1892), on examining twenty cases, reported in part a slight increase in eosins and marked increase in lymphocytes, in part normal findings. He did not state the period of the disease. Felsenthal (1892) found no leucocytosis in eight cases, but rather a diminished number of leucocytes, the proportion of white cells to reds with normal red count being 1:1000. The neutrophiles

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formed the bulk of the leucocytes, the mononuclear cells varying from 10 to 20 per cent., and the transitional from 5 to 8 per cent. He found the eosins not exceeding 1 per cent., and stated his belief that this with the absence of leucocytosis was of value in the diagnosis from scarlatina. Zappert (1893) found during the fever no rise of leucocytes and of eosins, but in convalescence a rise of 3 per cent. of the latter.

Sobotka then (1893) made the interesting observation that during the period of incubation of various acute infectious diseases—namely, pneumonia, scarlatina, varicella, small-pox, and measles—there occurs a leucocytosis, which persists in pneumonia and scarlatina throughout the acute stage, but in measles, small-pox, and varicella gives place to normal or subnormal counts shortly before the outbreak of the disease. He gave no figures to illustrate this, except in the case of small-pox. Klein (1893) noted an increase in the large mononuclear cells.

Türk (1898) made a very complete study of the blood in three cases, all adults. He found in all a diminution of the leucocytes during the rash, with a rapid return to normal during convalescence. The polynuclear neutrophiles were at first relatively, but not absolutely, increased, sinking later to normal or subnormal figures. Eosins were, during the eruption, normal or diminished, later increasing to normal or somewhat above (4.7 per cent.). The large mononuclear and transitional cells were increased during the later stages. The red cells and hemoglobin showed no changes worth mentioning. The blood plates were roughly estimated as scanty to normal during the eruption. Fibrin, as estimated by the amount of network in the fresh specimen, was scarce, sometimes plainly decreased. Türk drew the following conclusions: Uncomplicated measles never gives rise to leucocytosis, but rather to leucopenia; a leucocytosis, if present, points to a complication; the specific bronchitis of measles gives rise to no leucocytosis, except in the presence of a mixed infection; leucopenia or repeated normal counts point to measles or against scarlatina, while marked increase in eosins, especially with leucocytosis, is in favor of scarlatina.

Cabot (1898) gave figures from seven cases with normal and

subnormal white counts. In two cases of rubella the counts were 6,000 and 8,000 respectively.

Combe (1899) gave a brief abstract of the work of his pupil Renaud, whose monograph appeared the next year. Renaud examined four cases during incubation and found in all a polynuclear leucocytosis, setting in soon after infection occurred, and reaching its maximum six days before the appearance of the rash. The white count rose gradually to its maximum, then declined, reaching normal in the latter part of the stage of invasion. His maximum counts were 34,000, 17,000, 13,600, 17,300. He also studied the blood in twenty-three other cases of measles, all children. In uncomplicated cases he found constantly leucopenia, with lowest counts about twenty-four hours after the appearance of the rash. He recorded a count of 1,300 in the case of a two-year-old child on the third day of the rash; death five days later from bronchopneumonia. The leucocytes reached normal numbers from one to five days after the disappearance of the rash. The presence of leucocytosis always pointed to a complication, and was in some cases the first sign of the same. The absence of leucocytosis with a complication, or a marked and long-continued leucopenia in uncomplicated cases, was of bad prognostic import. He noted that a high normal count during the period when there should be leucopenia may have the same significance as a leucocytosis at a later stage. He concluded that the bronchitis and conjunctivitis of measles give rise to leucocytosis. It should be remembered, however, that his method of estimating the leucocytes (he counted only 256 of the small squares of a single Thoma-Zeiss chamber) would allow of a considerable error.

Renaud made differential counts in most of his cases, but only one or two in each. He found the neutrophiles increased, both relatively and absolutely, during the leucocytosis of incubation; at the time of the rash they decreased, contrary to the observations of Türk and Reckzeh. This may perhaps be accounted for by the fact that he placed the normal percentage in children too high. Eosins were in normal proportion until the outbreak of the eruption, when they disappeared entirely, to return during convalescence. Myelocytes were noted during the period of exanthem in

considerable numbers. Lymphocytes during the incubation were relatively decreased, absolutely increased, during the eruption, relatively increased. The red cells showed no changes. Renaud concluded that the presence of a leucocytosis in a person exposed to the contagion of measles showed that the disease has been contracted, provided that other causes of leucocytosis could be excluded. This, he thought, would be of great practical advantage in prophylaxis, for it is well known that by the time Koplik spots or other signs of measles have appeared, isolation is no longer effective.

Caccia (1900) reported the findings in twenty-three cases, of which fourteen were uncomplicated. In all of the latter leucopenia was present, being greatest on the first day of the rash and reaching normal about seven days later. Bronchopneumonia or diphtheria occurring during the rash gave normal or slightly increased counts, but not a marked leucocytosis, which is to be expected if this complication occurs during defervescence. Measles in a case of tuberculosis diminished a pre-existing leucocytosis, which reappeared during convalescence. His examinations of stained specimens were incomplete.

In his text-book on the examination of the blood, Ewing (1901) mentions three cases of his own occurring in malarial subjects in which leucocytosis was absent.

Reckzeh (1902) made repeated examinations in children in ten cases. His counts agree with those of other observers, showing leucopenia at the acme, increasing counts at the paling of the rash. He found no relation between the severity of the process and the lowness of the count. Frequently leucocytosis occurred during convalescence, most often due to inflamed glands, sometimes without assignable cause. He claimed that the bronchitis of measles gives rise to leucocytosis, but his tables hardly bear out this assertion. Cervical adenitis and otitis media caused leucocytosis; a case with broncho pneumonia had 8,000 white cells. Acute nephritis gave no leucocytosis. His differential counts agreed with those of Türk, except that he found the eosins constantly diminished during the rash.

The latest work on the subject is that of Plantenga (1903),

who made counts in twenty-nine cases of measles and ten cases of rubella, or German measles, all in children. In eight cases examined during the period of incubation he found a leucocytosis ranging from 20,000 to 33,000, due to increase of the neutrophiles and lasting till two days before the outbreak of the eruption. He thus confirms the observations of Sobotka and Renaud. He observed the usual leucopenia during the eruptive period. In rubella he recorded the same blood findings as in measles in every respect, including the leucocytosis during incubation, with the succeeding leucopenia. His differential counts were done in a liquid medium in the Thoma-Zeiss chamber, and therefore are hardly worthy of consideration. No clinical accounts of his cases were given.

It remains to mention certain attempts to find the etiological factor of measles in the blood. Giarré and Combe made cultures from the blood, with negative results. Barbier in ten cases reported cultures either negative or contaminated by the skin. Weber (1896) discovered protozoa in the blood during the eruptive stages of measles, scarlatina, and small-pox; his observations have not yet been confirmed by others.

PERSONAL OBSERVATIONS.

In the spring and summer of 1902 I made repeated examinations of the blood in twenty-eight hospital cases of measles, with the hope of rendering our knowledge of the blood picture more complete and of learning perhaps something of practical importance.

As the methods employed in this kind of work are of great importance, I shall describe them somewhat in detail. The white counts were done in a Thoma-Zeiss chamber, as modified by Elzholz; this permits of counting nine large squares with a single drop of fluid, instead of only one, as in the original chamber. At least two hundred white cells were counted at every examination; and sometimes as many as eight hundred. The blood was obtained from the lobe of the ear, with all the usual precautions against error, and a 1 per cent. solution of acetic acid, colored, as suggested by Türk, with gentian violet, was employed

as the diluting fluid. The dilution was usually 1:20, sometimes 1:10. Owing to lack of time, it was often necessary to make the counts after meals, and so in some cases the element of digestion leucocytosis must be reckoned with. The patients were all on liquid diet until after defervescence; this, as is well known, gives rise to no digestion leucocytosis. In convalescence they were on a mixed diet, consisting of a breakfast of carbohydrates at 8 A. M.; dinner, with meat and vegetables, at noon; and a light supper at 5:30 P. M. As the hour at which the count was made is always given, it is possible to make due allowance for the effects of digestion. The red counts were done by the Thoma-Zeiss method, using Gowers's solution and a dilution of 1:200; usually 1,500 red cells were counted. The hemaglobin was estimated by the Tallquist method, which, allowing an error of about 10 per cent., proved satisfactory in my hands. I do not consider it sufficiently accurate for scientific purposes.

In making the differential counts, the classification of Ehrlich was followed, as being that most generally in use. The stain employed was Jenner's, as modified by Leishman (polychrome methylene blue and eosin in one solution). This gives clearer pictures than the Ehrlich triple stain, especially as to the nuclei and the mast cells, and is at the same time easier and surer of application. It was attempted to distinguish between the large lymphocytes and the large mononuclear cells, but this was found too difficult to be of practical value, there being many cells which might be called one or the other according to the standard of the observer. I therefore included the large lymphocytes, large mononuclear, and transitional forms in one group. Four hundred cells were counted in each instance. The blood-plates were not counted, but roughly estimated as normal, increased, or diminished in number.

The patients being hospital cases and many of them children, the histories were often incomplete. In such instances I have assumed that the rash appears on the fourth day of the disease. The treatment was purely symptomatic, and in most cases no drugs were used, except a simple cough mixture. Patients were kept in bed until several days after defervescence.

Before considering the cases, it remains to discuss briefly normal blood. For fasting adults the normal white count may be placed at 7,500, with extreme variations between 5,000 and 10,000. After a meal containing proteids a rise of from 2,000 to 4,000 may be expected, but not always. The polynuclear neutrophiles will be found to make up 60–75 per cent.; the lymphocytes, 18–25 per cent.; the large mononuclear and transitional, 2–4 per cent.; eosins, 1–4 per cent.; mast cells, 0– $\frac{1}{2}$ per cent.

In young children and infants the white count is higher than in adults, and leucocytosis more easily produced and higher in proportion to the cause. For infants the normal number varies from 10,000 to 15,000, with an increase at times to 20,000 or above from slight or unassignable causes. In the second year the count is about 12,000, falling gradually until it reaches that normal for adults at about the tenth year. Children show a marked decrease in polynuclear neutrophiles and an increase in lymphocytes, as compared with adults; Gundobin, for instance, found in normal infants during the first year 28–40 per cent. neutrophiles and 50–60 per cent. lymphocytes; in the second year, about the same relations; in the third year, 55 per cent. neutrophiles and 39 per cent. lymphocytes; after that, a gradual change until adult proportions are reached at about the tenth year. Digestion leucocytosis is the same as, or somewhat greater than, in the adult.

Furthermore, the blood may be modified by pre-existing chronic disease; as, for example, an increase in the lymphocytes may be the result of rickets or “scrofulous affections,” or even of simple debility, as shown by Cabot. All this emphasizes the necessity of individualizing before drawing conclusions from blood examinations, as pointed out by Türk, and taking all the factors into consideration. A white or differential count which is normal for one individual may be pathological for another.

CASE I.

DIAGNOSIS — MEASLES.

Female, age twenty-five years. Past history: Mumps and scarlatina in childhood.

Present illness: Onset May 8, with nausea, headache, cough, and rash.

Physical examination, May 10: Well nourished. Considerable prostration; vomiting; conjunctiva and throat congested; Koplik spots on both cheeks; eruption on roof of mouth; typical maculopapular rash over body, confluent on face and chest. A few râles; systolic murmur at apex.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 10, 5 P. M...	6	103.2	4,600	85.50	8.75	5.50	0	0.25	—	Hg. 85% red cells 5,208,000.
May 13.	9	99.3	6,000	49.75	32.75	16.50	0.75	0.25	Sl.—	Rash fading; desquamation on face.
May 16.	12	98.5	9,200	68.00	22.25	8.00	1.25	0.50	—	Some remains of rash; convalescent.
May 19, 12 M.	15	98.7	11,400	80.00	15.00	4.00	0.50	0.50	N.	Rash gone; desquamation present.
May 23, 3:30 P. M.	19	98.8	11,400	79.25	17.25	2.75	0.50	0.25	N.	19th, Hg. 85%; red cells 4,996,000.
May 29, 4:30 P. M.	25	....	10,800	71.50	20.75	6.75	0	1.00	N.	Heart normal; very slight desquamation; discharged well May 30.

CASE II.

DIAGNOSIS — MEASLES.

Male, age twenty-seven years. Past history: Whooping cough in childhood.

Present illness: Onset May 7, with fever, coryza, pains in limbs, vomiting. Cough three days. Rash appeared today.

Physical examination, May 13: Well developed and nourished. Conjunctivitis; Koplik spots; maculo papular rash, becoming confluent on face, discrete on trunk, absent on legs; eruption on roof of mouth. Soft systolic murmur; few râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 13, 5 P. M...	6	101.0	8,200	79.40	11.20	9.20	0.20	0	—	500 cells counted.
May 16, 5 P. M...	9	99.5	6,700	64.00	24.50	7.25	4.00	0.25	Sl. —	Vomiting and diarrhea on 14th; petechae on abdomen and back today.
May 19, 12:30 P. M.	12	98.1	10,100	77.75	15.25	4.75	2.00	0.25	N.	Comfortable; petechae fading; no râles; desquamation present.
May 22, 6 P. M...	15	97.8	10,500	70.50	25.00	2.25	2.00	0.25	N.	Up; good convalescence; hg. 90%; red cells 4,796,000.
May 26, 11:30 A. M.	19	97.6	14,900	80.25	16.00	2.25	1.50	0	N.	Nothing objective to account for leucocytosis
May 29, 1 P. M...	22	99.8	9,400	75.75	14.75	7.00	2.00	0.50	+	Still slight desquamation on hands.
June 4, 3:30 P. M.	28	98.5	9,200	68.50	24.50	1.50	5.00	0.50	—	Heart normal; discharged well.

CASE III.

DIAGNOSIS — MEASLES.

Male, age twenty-one years. No history obtained.

Physical examination, May 5: Well developed and nourished. Eyes suffused: numerous Kopliks; mouth and throat red; characteristic maculopapular eruption, confluent on face, discrete on trunk and extremities. Soft systolic murmur at apex; numerous coarse râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 5, 3:30 P. M.	5±	102.3	3,000	84.00	9.50	6.25	0	0.25	—	
May 7, 8 A. M. . . .	7	98.7	3,900	63.25	20.75	11.25	4.75	0	—	Crisis today; 1 myelocyte seen; rash fading.
May 9, 8 A. M. . . .	9	98.0	5,100	50.25	37.50	9.25	2.75	0.25	—	Rash gone except where it has been petechial; no râles.
May 12, 9 A. M. . . .	12	97.9	5,900	63.50	27.25	7.75	1.00	0.50	—	
May 15, 11:30 A. M.	15	98.4	6,100	71.75	16.00	10.75	1.25	0.25	N.	Normal convalescence
May 18, 8:30 A. M.	18	....	6,900	72.50	19.00	6.75	1.00	0.75	N.	Hg. 75%.
May 23, 10:30 A. M.	23	....	6,300	69.50	22.00	7.00	1.25	0.25	—	Heart normal; discharged well May 24.

CASE IV.

DIAGNOSIS — MEASLES.

Male, age about twenty-five years. No history obtained.

Physical examination, May 15: Well developed and nourished. Conjunctivæ red; mouth and throat injected; Koplik spots present; macular rash on roof of mouth; the characteristic rash of measles is present, confluent on the face, discrete elsewhere. Systolic murmur and a few râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 6	5±	105.6	5,300	81.25	14.00	4.50	0	0.25	N.	Hg. 95%; red cells 5,168,000; much prostration; cold bath at 9 P. M. and 1 A. M.
May 18; 3:30 P. M.	7	100.8	7,500	70.00	20.00	5.50	4.50	0	—	Yesterday rash very brilliant, fading today; desquamation beginning; 1 myelocyte seen.
May 20, 5 P. M. . .	9	98.3	7,100	52.75	36.50	6.75	3.50	0.50	sl.—	Rash gone except petechæ; few râles; 1 myelocyte seen.
May 24, 3 P. M. . .	13	98.4	13,200	74.00	21.50	1.75	2.50	0.25	+	Hg. 90%; reds 5,876,000; hot day, sweating; no râles; convalescent.
May 29, 2 P. M. . .	18	98.3	10,200	78.00	18.50	1.50	2.00	0	N.	Discharged well.
June 5, 8 A. M. . .	25	....	11,900	82.00	12.00	4.25	1.25	0.50	—	

CASE V.

DIAGNOSIS — MEASLES.

Male, age eighteen months; transferred from Massachusetts General Hospital, where he had been treated for pneumonia.

Physical examination, May 16: Pale child with well-marked rachitis. Conjunctivae red; slight coryza; Koplik spot on right cheek; rash on hard palate; fading eruption of macules and papules characteristic of measles, confluent on the face, elsewhere discrete; beginning desquamation. Systolic murmur. A few scattered moist râles; discharging ischiorectal abscess.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	White Cells	Blood Plates	Remarks
May 17.....	6±	102.7	5,200	40.75	53.50	4.50	1.25	0	—	Hg. 60%; reds 4,409,000; eruption fading; small abscess on buttock incised and drained; 4 myelocytes seen; achromia.
May 19, 5 P. M...	8	103.6	9,300	46.50	45.25	5.25	3.00	0	N.	Rash nearly gone; rapid respiration; numerous râles; 4 normoblasts; achromia.
May 21, 10:30 A. M.	10	98.8	10,100	48.00	41.00	6.25	4.50	0.25	+	Condition good; crisis; localized bronchitis right apex; achromia poikilocytosis; 4 normoblasts; 2 myelocytes; 2 megaloblasts
May 24, 5:30 P. M.	13	99.3	20,100	69.50	20.50	9.00	0.50	0.50	+	Abscess incised yesterday; June 15, whites 9,700; reds 5,188,000; Hg. 75%; discharged well June 16.
May 29, 6:30 P. M.	18	.....	11,200	.....	.....	.....	.....	.....	.....

CASE VI.

DIAGNOSIS — MEASLES.

Male, age five years. Past history: Entered hospital April 16 with scarlatina. On May 12 the temperature rose to 103°. Normal next day. Koplik spots were seen on the 14th, and the rash of measles on the 17th.

Physical examination, May 17: Well-developed, fairly nourished boy, with discharge from both ears (scarlatina). Bright maculopapular eruption of measles, chiefly on face, sparse on body and legs.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 17.....	5	104.0	9,000	71.25	24.00	4.75	0	0	—	Hg. 55%; reds 3,256,000; 3 myelocytes; achromia.
May 19, 4:30 P. M.	7	100.2	9,200	40.75	50.75	7.25	1.25	0	N.	Mild case; eruption already gone; euphoria; 5 myelocytes.
May 22, 5:30 P. M.	10	98.8	10,400	36.75	48.50	9.25	4.75	0.75	N.	General desquamation; reds show achromia and poikilocytosis.
May 26, 5 P. M. . .	14	98.6	13,300	39.75	52.25	6.25	1.25	0.50	N.	Digestion leucocytosis; 1 myelocyte.
May 31, 3 P. M. . .	19	98.8	11,700	45.25	47.75	5.00	0.50	1.50	+	Discharge from ears ceased; good convalescence.
June 6, 8 A. M. . .	25	98.7	8,500	53.25	40.50	5.00	0.50	0.75	N.	Hg. 65%; reds 4,852,000. Discharged well June 8.

CASE VII.

DIAGNOSIS — MEASLES.

Female, age 25 years. Past history: Measles, mumps, varicella, and scarlatina in childhood.

On May 28 the present illness began, with pains in limbs and cough; later, soreness of eyes. Two days later the rash broke out.

Physical examination, May 31: Well developed and nourished. Eyes suffused and red; macular rash on hard palate, but no Koplik spots; on the body a typical maculopapular rash, most abundant on face, sparse on extremities. Soft systolic murmur at apex; occasional dry râle.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 1, 10 A. M..	4	101.0	6,700	74.50	20.25	4.75	0.25	0.25	—	Hg. 85%; rash still bright.
June 3.....	6	98.5	....	53.75	30.75	11.50	3.50	0.50	N.	1 myelocyte.
June 4, 3:30 P. M.	7	99.0	11,200	50.00	37.50	9.25	2.75	0.50	N.	Rash gone; no desquamation.
June 7, 9 A. M....	10	98.2	13,100	58.00	31.00	7.25	3.25	0.50	—	Slight coryza; no cause for leucocytosis apparent.
June 10, 10 A. M..	13	98.5	14,800	67.75	22.50	5.25	4.50	0	N.	
June 13, 11 A. M..	16	98.5	11,600	71.25	19.75	4.75	3.50	0.75	N.	Slight desquamation on feet.
June 18, 10 A. M..	21	....	12,000	54.50	37.00	5.00	2.75	0.75	....	Discharged well June 19.

CASE VIII.

DIAGNOSIS — MEASLES.

Male, age twenty-one years. Measles three years ago. Present illness came on May 20, with cough and fever.

Physical examination, May 23: Well developed and nourished. Conjunctivae; mouth and throat reddened; Koplik spots on both cheeks; macular eruption on hard palate; bright-colored blotchy eruption over entire body, thickest on face. Heart negative; a few dry rales. Enlarged glands under angles of jaw. Temperature 103.4°.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 24, 10 A. M..	5	98.5	5,600	45.75	41.25	10.75	2.25	0	—	Hg. 95%; reds 5,000,000; rash beginning to fade on extremities; crisis.
May 26, 1 P. M....	7	98.2	8,100	53.25	34.50	8.75	3.50	0	—	Rash still evident.
May 29, 1:30 P. M.	10	98.4	13,600	77.25	13.25	6.00	3.00	0.50	N.	Probably digestion leucocytosis; rash gone; desquamation.
June 2, 7 P. M....	14	97.5	14,900	71.50	16.00	8.50	3.50	0.50	N.	Digestion leucocytosis; convalescent.
June 6, 9 A. M....	18	98.9	6,200	62.25	20.50	14.25	2.75	0.25	N.	Discharged well June 13.
June 11, 10 A. M..	23	98.4	7,600	63.00	28.75	5.25	2.50	0.50	—	

CASE IX.

DIAGNOSIS — MEASLES.

Female, age eight years. Diphtheria two and one-half years ago, followed by stenosis of larynx, in consequence of which tracheotomy was performed and later gradual dilatation with sounds.

Present illness began May 18, with cough, lachrymation, coryza, and dyspnea.

Physical examination, May 23: Well developed and nourished. Suffusion of eyes; mouth and throat red; a few Koplik spots on cheeks; macular eruption on hard palate; discrete reddish macules and papules scattered over face, trunk, and extremities. Heart negative; scattered râles. Laryngeal stenosis, requiring insertion of tracheotomy tube through the old scar; this happens often with her in "catching cold," as it has been impossible to dilate the stenosed part sufficiently.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 24, 12:30 P. M.	6	101.0	9,400	83.75	13.50	2.75	0	0	—	Hg. 80%; reds 5,309,000; rash still present on 25th; respiration easy.
May 26, 5:30 P. M.	8	98.8	9,000	36.00	52.75	8.50	2.50	0.25	—	Crisis yesterday; rash gone; euphoria.
May 29, 4 P. M. . .	11	98.5	8,700	60.75	29.50	6.00	3.50	0.25	N.	Desquamation: still a few dry râles; 1 myelocyte.
June 1, 11 A. M. . .	14	98.7	16,200	73.50	17.25	5.75	2.75	0.75	N.	Up; no cause found for leucocytosis; no symptoms.
June 5, 7:30 A. M.	18	98.1	8,100	62.50	22.75	9.25	4.75	0.75	N.	Doing well.
June 9, 9 A. M. . .	22	98.5	6,900	62.75	28.50	6.00	2.25	0.50	N.	Discharged well June 10.

CASE X.

DIAGNOSIS — MEASLES.

Male, age twenty-two years. Mumps four years ago; rheumatism five years ago. Present illness began May 23, with cough, sneezing, and headache.

Physical examination, May 27: Fairly developed and nourished. Eyes suffused; mouth and throat reddened; macular eruption on hard palate; characteristic maculopapular rash on body, confluent on the face. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 27, 5:30 P. M.	5	101.0	6,600	80.75	13.00	5.50	0.50	0.25	—	
May 29, 3 P. M. . .	7	98.8	6,700	40.75	40.50	11.00	7.75	0	N.	Rash fading; face beginning to desquamate; feeling better.
May 31, 12:30 P. M.	9	98.5	5,600	55.50	29.00	10.25	4.25	1.00	+	Well-marked desquamation.
June 2, 5:30 P. M.	11	97.7	9,700	74.00	17.50	6.00	2.25	0.25	SL. —	
June 5, 8:30 A. M.	14	98.2	7,300	62.00	23.50	11.00	3.00	0.50	—	
June 8, 10:30 A. M.	17	98.2	5,400	56.75	28.75	11.25	3.00	0.25	N.	Normal convalescence.
June 13, 10 A. M.	22	98.2	8,300	72.50	19.00	6.25	2.00	0.25	N.	
June 17, 8 A. M. . .	26	98.1	5,800	73.25	11.75	13.25	1.75	0	N.	Still shows desquamation on hands and feet.
June 20, 9:30 A. M.	29	....	7,700	65.00	21.75	10.50	2.75	0	N.	Discharged well June 20.

CASE XI.

DIAGNOSIS — MEASLES.

Female, age twenty-two years. Past history: "Measles at the age of one week;" typhoid ten years ago.

Present illness began June 11, with headache, sore throat, followed by cough, lachrymation, and sneezing, and discharge from the right ear. Rash appeared on June 13, first on the face.

Physical examination, June 13: Well-developed, stout woman. Nasal and aural discharge; moderate conjunctivitis; throat red; Koplik spots on both cheeks; eruption on hard palate; on the skin a maculopapular eruption, confluent on the face, discrete on the trunk and thighs, none on the legs. Heart not enlarged; slight systolic murmur; occasional râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 13, 5 P. M. . .	3	99.2	2,500	81.75	14.25	3.50	0.50	0	—	Hg. 80%; on 14th temperature 104; rash out on legs.
June 15, 3 P. M. . .	5	101.2	3,200	72.40	24.60	3.00	0	0	—	Brilliant rash.
June 17, 12 M. . . .	7	98.0	4,000	51.50	36.00	10.50	2.00	0	—	Rash fading on 16th; abundant desquamation; conjunctivitis.
June 20, 7:30 A. M.	10	98.0	5,400	53.50	36.00	8.75	1.75	0	N.	No discharge from ear; conjunctivitis better.
June 24, 9:30 A. M.	14	98.5	11,300	75.00	17.00	7.50	0.50	0	N.	Up on 22d.
June 28, 2:30 P. M.	18	....	10,100	66.00	26.00	6.75	0.75	0.50	N.	
July 2,	22	....	19,300	56.00	39.25	3.50	1.00	0.25	—	Discharged well July 4; still soft systolic murmur at apex.

CASE XII.

DIAGNOSIS — MEASLES.

Female, Syrian, age four and one-half years. Sister of Case XXI. Present illness began June 11.

Physical examination, June 13: Fairly developed and nourished. Considerable prostration; conjunctivitis; profuse nasal discharge, and tender glands in the neck; many Koplik spots; eruption on the roof of the mouth and on the body, where it is sparse, consisting of scattered single macules and papules on face, trunk, arms, and thighs. Slight systolic murmur at apex; fine moist râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 13, 6:30 P.M.	4	102.0	8,400	65.75	28.50	5.50	0	0.25	N.	Hg. 65%; slight achromia; 2 myelocytes.
June 15, 3:30 P.M.	6	102.5	8,900	73.00	25.00	2.00	0	0	N.	Rash now typical and profuse; cough increased and a few râles; 5 myelocytes.
June 17, 11:30 A.M.	8	98.0	10,600	75.25	17.00	7.25	0.25	0.25	....	Desquamation on 16th; crisis today, rash fading; 1 myelocyte.
June 20, 10 A.M.	11	98.1	13,800	66.00	25.75	7.00	1.25	0	N.	Faded remains of rash visible; cough and a few râles; 2 myelocytes.
June 23, 9:30 A.M.	14	98.0	12,500	62.75	30.50	5.50	0.75	0.50	N.	Up.
June 27, 9:30 A.M.	18	98.5	14,700	64.50	27.75	6.50	0.75	0.50	N.	Red cells normal; Hg. 75%.
July 1, 2:30 P.M.	22	98.5	8,700	69.75	23.50	5.00	1.50	0.25	N.	Good convalescence.
July 5, 1 P.M.	26	....	12,800	71.25	22.75	5.50	0.50	0	N.	Discharged well July 10.

CASE XIII.

DIAGNOSIS — MEASLES.

Male, age 1 year, 4 months. Is said to have had measles before. Entered the hospital with scarlatina April 23, and had a fairly mild attack, complicated by otitis media and adenitis. On June 12 the temperature rose to 102°, and there were cough and restlessness; no Koplik spots. On the 14th a typical measly eruption appeared on the face, and sparsely over the body; cough, coryza, sneezing. Patient is well developed and fairly nourished; Koplik spots present. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 18, 11:30 A. M.	....	98.8	9,900	51.00	41.50	3.75	3.75	0	....	Exposed May 22. Hg. 65%; achromia of red cells.
June 14, 9 A. M. . .	3	102.1	5,600	59.25	36.25	4.50	0	0	N.	
June 17, 10 A. M. .	6	98.8	10,100	40.75	48.50	9.00	1.25	0 50	N.	Crisis on 15th; rash nearly gone; suppu- rating glands incised and drained; achromia and poikilocytosis of red cells
June 19, 8 A. M. . .	8	98.7	13,700	58.75	31.50	8.50	1.25	0	N.	Cytosis; 1 megaloblast; 1 myelocyte.
June 22, 10:30 A. M.	11	98.2	7,600	44.00	41.00	11.75	2.50	0.75	N.	Abscess doing well.
June 26, 11 A. M. .	15	98.5	8,000	36.25	48.75	13.50	1.25	0.25	N.	Glands healed; achromia, but no nucleated reds.
July 1, 3 P. M. . . .	20	98.4	7,800	39.00	43.50	14.50	1.50	1.50	Sl. +	Discharged well July 26.
July 5, 3:30 P. M.	24	....	10,300	15.00	66.00	18.50	0.50	0	+	

CASE XIV.

DIAGNOSIS — MEASLES.

Male, age twenty-seven years. Measles, scarlatina, and influenza in childhood. On June 13 nausea, anorexia, pain in the legs. No cough, coryza, or lachrymation. Rash appeared on evening of June 14 on back of neck and shoulders.

Physical examination, June 15: Well developed and nourished. Slight redness of conjunctivæ and suffusion; fauces congested; macular eruption on hard palate and Koplik spots on the cheeks; typical maculopapular eruption all over body, most marked about shoulders. Faint systolic murmur; occasional fine moist râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 15, 2 P. M.	3	102.2	7,000	81.00	13.00	6.00	0	0	—	Hg. 90%.
June 17, 10:30 A. M.	5	99.7	5,600	62.00	27.75	8.75	1.25	0.25	—	Rash almost gone; euphoria; very mild case.
June 19, 7:30 A. M.	7	98.7	7,000	54.00	30.00	14.75	1.00	0.25	N.	Desquamation began yesterday; up on 20th.
June 22, 10 A. M.	10	98.0	11,100	71.75	20.50	4.50	2.75	0.50	N.	Hg. 90%.
June 26, 11:30 A. M.	14	....	7,900	63.75	31.00	5.00	0	0.25	Sl. +	Discharged well June 27.
July 1, 2 P. M.	19	....	6,000	58.50	28.25	10.75	1.75	0.75	N.	Returned for examination of blood.
July 6, 2 P. M.	24	....	6,400	52.00	35.75	12.00	0	0.25	Sl. —	Ditto.

CASE XV.

DIAGNOSIS — MEASLES.

Female, age one year. Patient entered the hospital with scarlatina March 14, and was discharged well June 5. June 15 she re-entered the hospital with measles. History not obtained.

Physical examination, June 15: Fairly developed and nourished; general condition good. Coryza; conjunctivitis with photophobia; very numerous Koplik spots; no rash. Slight systolic murmur at apex; a few râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 15, 4 P. M. . .	3	100.4	11,900	38.25	54.50	6.75	0.25	0.25	—	Hg. 85%; rash appeared on 16th on face and chest.
June 17, 2 P. M. . .	5	102.9	5,400	60.50	34.00	5.50	0	0	—	Typical blotchy rash on face, scattered on trunk; coryza and cough.
June 19, 10 A. M. .	7	99.2	8,900	31.50	57.25	9.50	1.75	0	N.	Rash at its height yesterday; numerous moist râles; 1 normoblast; no achromia.
June 22, 11 A. M. .	10	99.1	22,400	44.25	44.75	9.50	1.50	0	+	Râles fewer; leucocytosis probably due to small patch pneumonia.
June 25, 6 P. M. . .	13	99.1	20,900	33.00	53.00	1.36	0.4	0	N.	Still numerous râles and cough.
June 28, 3 P. M. . .	16	98.5	16,000	36.25	55.00	8.50	0.25	0	Sl. +	Temperature 101.2° on 15th; cough and few râles; coryza.
July 2, 2:30 P. M.	20	100.1	23,100	46.75	43.75	9.50	0	0	N.	No râles; still coughs. Discharged well July 7.
July 6, 2:30 P. M.	24	.....	12,500	36.00	55.00	7.00	2.00	0	—	

CASE XVI.

DIAGNOSIS — MEASLES, LARYNGITIS, OTITIS MEDIA.

Male, Italian, age twenty-five years. No history obtained.

Physical examination, May 7: Well developed, fairly nourished. Conjunctivæ reddened; Koplik spots present; characteristic maculopapular eruption all over body. Many scattered râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 8, 5 P. M...	6±	100.7	4,400	61.25	17.50	7.75	13.50	0	—	Hg. 90%; reds 5,024,000.
May 11, 11 A. M...	9	100.0	8,800	74.75	14.25	4.00	6.75	0.25	—	Very hoarse; rash nearly gone on 12th, purulent discharge from right ear.
May 14, 5 P. M...	12	101.9	9,900	51.50	31.50	5.50	10.50	1.00	N.	Severe bronchitis still with hoarseness
May 18, 4 P. M...	16	100.0	10,600	69.25	20.25	6.25	3.00	1.25	—	Hg. 90%; reds 4,868,000; less cough; still râles and hoarseness.
May 22, 4 P. M...	20	99.0	10,400	67.50	21.00	5.25	5.75	0.50	N.	Ear still discharging; râles.
May 26, 10:30 A. M.	24	99.0	10,200	60.25	28.50	2.00	8.00	1.25	N.	Hg. 90%; reds 5,328,000; diarrhoea; slight aural discharge.
June 1, 11:30 A. M.	30	98.6	9,600	56.50	23.75	8.00	11.00	0.75	N.	Up on 28th.
June 7, 8 A. M....	36	98.6	9,000	74.50	14.75	3.50	6.75	0.50	—	Discharged well.

CASE XVII.

DIAGNOSIS — MEASLES, OTITIS MEDIA, MASTOIDITIS, PHTHISIS.

Female, age fourteen years. Past history: Chronic discharge from both ears, off and on, since age of seven. Present illness began May 19 with headache, fever, coryza.

Physical examination, May 21: Fairly well developed and nourished. Conjunctivæ and throat injected; Koplik spots present; characteristic rash on roof of mouth and skin, confluent on the face, discrete elsewhere. Heart negative; moist and dry râles present. Temperature 104.8°.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 22, 3:30 P.M.	4	102.0	5,900	83.75	13.00	3.25	0	0	—	Hg. 90%; red cells 5,356,000; rash same as yesterday.
May 24, 6 P. M. . .	6	98.5	7,200	49.00	41.50	8.00	1.50	0	N.	Rash fading; desquamation beginning.
May 26,	8	98.2	9,000	56.25	34.50	7.25	1.75	0.25	+	Rash gone.
May 29, 6 P. M. . .	11	99.3	12,500	69.75	22.00	8.25	0	0	N.	Right ear began to discharge yesterday; left ear aches.
June 1, 10:30 A.M.	14	100.2	16,200	76.75	16.75	6.50	0	0	+	Temperature 101° yesterday; left ear now discharging; partial deafness.
June 4, 5 P. M. . .	17	103.2	14,700	83.25	13.75	2.50	0.25	0.25	...	Profuse discharge; no mastoid tenderness; 1 myelocyte.
June 7, 6 P. M. . .	20	101.6	9,200	62.00	31.50	5.25	1.25	0	—	Less discharge.
June 12, 3:30 P.M.	25	99.9	11,300	73.00	21.00	4.50	1.50	0	N.	No discharge from left ear, slight from right.
June 16, 9:30 A.M.	29	98.7	16,100	70.75	24.50	3.75	0.50	0.50	+	Tender swelling in front right ear appeared yesterday; right ear still running.
June 20, 10:30 A.M.	33	98.3	8,700	59.50	33.00	7.50	0	0	+	
June 23, 9 A. M. . .	36	98.0	9,800	77.50	16.25	6.00	0.25	0	SL.—	Swelling in front of ear persists; edema of anterior wall of auditory canal; swelling and tenderness over mastoid.
June 26, 9:30 A.M.	39	100.0	7,100	66.50	21.50	11.75	0	0.25	SL.—	On 25th slight hemoptosis, temperature 103°; no tubercle bacilli in sputum; scattered coarse râles; cervical glands enlarged. On 26th operation; mastoid full of pus; curetted and drained.
June 29, 10:30 A.M.	42	100.2	10,900	47.75	41.50	10.25	0.25	0.25	N.	Moderate fever till July 21; July 29 signs of infiltration at left apex. Discharged to Convalescent Home.

CASE XVIII.

DIAGNOSIS — MEASLES, OTITIS MEDIA, MASTOIDITIS.

Female, age twenty-three years. Acute articular rheumatism five years ago. Onset of present illness May 23, with cough, and rash, appearing first on forehead.

Physical examination, May 27: Well developed and nourished. Eyes suffused; mouth and throat reddened; macular eruption on hard palate; Koplik spots present; on the skin there is a bright maculopapular rash, confluent on the face, elsewhere discrete. The heart shows enlargement to the left, a systolic murmur at the apex, and accented pulmonic second sound (mitral regurgitation); lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 27, 5 P. M...	5	104.0	4,800	84.50	11.50	4.00	0	0	+	Strych. gr. $\frac{1}{2}$ every 4 hours.
May 29, 5 P. M...	7	100.8	4,700	61.50	20.00	10.00	7.75	0.75	N.	Rash fading.
May 31, 1 P. M...	9	97.7	4,300	49.00	37.00	10.25	3.50	0.25	N.	Cough; lungs negative; rash not quite gone.
June 2, 6 P. M...	11	98.6	16,300	79.75	13.75	4.00	1.75	0.75	N.	Yesterday ear-ache on right with congestion and bulging of drum head.
June 5, 3:30 P.M.	14	99.2	10,000	68.75	20.00	8.50	1.75	1.00	N.	Right ear still aches, but does not discharge; desquamation.
June 8, 10 A. M...	17	100.0	14,700	74.00	16.25	8.25	1.00	0.50	N.	Purulent discharge from right ear since yesterday; irrigation.
June 12, 4 P. M...	21	100.4	13,100	68.50	25.00	3.50	1.00	2.00	N.	Still much aural discharge.
June 16, 9 A. M...	25	99.5	10,800	74.25	11.50	10.25	2.00	2.00	Sl. +	Gaining strength slowly; paracentesis of right ear on 21st.
June 20, 10 A. M.	29	99.0	12,900	63.75	23.50	7.75	2.75	2.25	+	Discharge continues; tender over mastoid 2 weeks; July 8 operation and pus found. July 29 discharged relieved.
July 7, 6:30 P.M.	46	98.7	11,300	64.00	26.00	5.50	2.75	1.75	...	

CASE XIX.

DIAGNOSIS — MEASLES, TONSILITIS.

Male, age twenty-three years. Past history negative. Present illness began May 18 with cough, fever, and lachrymation.

Physical examination, May 23: Well developed and nourished. Eyes suffused; throat red; Koplik spots present; typical maculopapular eruption on face and body, thickest on face. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 23, 6 P. M...	6	102.3	8,900	85.25	9.75	4.25	0.50	0.25	—	Rash fading. Few sonorous rales; less cough; desquamation yesterday.
May 25, 5:30 P.M.	8	98.3	10,700	56.50	36.25	5.75	1.50	0	N.	
May 29, 3:30 P.M.	12	98.2	14,000	73.25	20.00	5.75	0.75	0.25	N.	
June 2, 6:30 P.M.	16	98.0	19,000	72.00	19.50	7.25	0.75	0.50	N.	May 31, sore throat; fever 102.8; tonsils swollen with exudate.
June 4, 6:30 P.M.	18	99.0	19,000	72.00	23.50	3.75	0	0.75	N.	Exudate still present on tonsils; up since 3d.
June 5, 9 A. M...	20	.....	17,800	74.50	20.25	4.50	0.50	0.25	N.	Chronic pharyngitis and enlarged tonsils; no exudate; June 12, discharged well.
June 10, 10:30 A.M.	24	98.5	16,600	67.50	25.25	6.50	0.25	0.50	N.	

CASE XX.

DIAGNOSIS — MEASLES DURING CONVALESCENCE FROM SCARLATINA, DIPHTHERIA.

Male, age nine years. Past history: Scarlatina beginning April 29; on May 14 fever to 102.7°; next day cough, sneezing; Koplik spots. Glands in neck much enlarged; no rash.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 15, 5 P. M. . .	2	101.1	16,700	74.80	9.80	13.21	1.20	0.80	N.	Hg. 75%; reds 4,180,000; leucocytosis may be due to previous scarlatina.
May 17, 5:30 P. M.	4	100.0	8,300	76.25	11.75	11.75	0	0.25	Sl. +	More Koplik's spots; euphoria; suffusion of eyes.
May 18, 5 P. M. . .	5	100.0	9,500	83.75	6.75	9.25	0	0.25	N.	Ether at 12 M. for extraction of tooth.
May 19, 3:30 P. M.	6	103.4	7,500	79.75	8.00	11.25	0	1.00	—	Typical rash appeared first on face then on whole body except abdomen; coryza; cough.
May 20, 5:30 P. M.	7	103.4	7,300	74.00	18.50	7.00	0.50	0	N.	Very profuse rash.
May 21, 3:30 P. M.	8	101.2	11,800	73.25	18.75	7.00	1.00	0	N.	Rash fading; desquamation of scarlatina on thigh; numerous dry râles.
May 23, 5 P. M. . .	10	102.8	32,000	76.00	19.25	4.25	0.25	0.25	...	Stenosis larynx intubation, antitoxine 12,000 units; coughed up membranes; 1 myelocyte seen.
May 24, 5 P. M. . .	11	103.0	24,100	71.50	21.75	6.75	0	0	N.	Breathes easily through tube; Hg. 80%; red cells 5,000,000.
May 26, 12:30 P. M.	13	102.0	21,900	66.00	22.50	11.50	0	0	Much +	Positive culture from nose and throat; extubed yesterday; strychn. and brandy every 4 hours.
May 30, 6 P. M. . .	17	99.2	17,800	78.00	14.75	6.25	0.50	0.50	+	Purulent discharge from ears, and culture shows diphtheria bacilli.
June 4, 4:30 P. M.	22	98.6	16,600	79.50	15.75	4.50	0.25	0	—	Aphonia; achromia in red cells.
June 11, 9:30 A. M.	29	98.4	11,900	69.75	18.75	11.00	0.25	0.25	N.	Reds 4,696,000; Hg. 55%; convalescent. Discharged well July 4.

CASE XXI.

DIAGNOSIS—MEASLES, BRONCHOPNEUMONIA, DIPHTHERIA.

Male, Syrian, age two years. One sister has measles (case No. 12). Present illness began June 10.

Physical examination, June 13: Fairly nourished, marked rachitis; throat red; a slight eruption on hard palate; Koplik spots on both cheeks; on face, neck, and chest a fine discrete maculopapular rash, less marked on the abdomen, thighs, and arms; cervical glands enlarged. Systolic murmur at apex; marked general bronchitis; spleen palpable two fingers below costal margin.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 13, 6 P. M...	4	99.0	8,100	64.50	25.00	10.00	0	0.50	—	Hg. 85%; strychn. gr. $\frac{1}{4}$ every 4 hrs.
June 15, 2:30 P. M.	6	102.7	9,100	50.50	37.25	11.75	0.25	0.25	—	Eruption sparse until yesterday, now at its height; nasal discharge; dry rales; 2 myelocytes.
June 17, 11 A. M..	8	100.3	13,100	52.50	35.25	11.25	1.00	0	—	Rash fading; desquamation; 1 myelocyte.
June 20, 8 A. M...	11	99.0	19,100	60.25	28.75	9.25	1.00	0.75	—	Rash still visible till today; rales more numerous and moist; expiratory grunt; 2 myelocytes.
June 23, 9 A. M...	14	99.5	15,900	62.50	30.25	6.00	0.50	0.75	+	On 21st temperature 102.3°; bronchial breathing and consonating rales at right apex; no signs of consolidation; 2 myelocytes.
June 26, 10 A. M..	17	99.7	15,300	64.75	28.25	6.00	0.75	0.25	N.	Few rales; laryngeal cough; slight difficulty in breathing.
June 28, 10:30 A. M.	19	101.0	31,800	84.25	12.00	3.75	0	0	N.	Stenosis larynx; intubation with relief; antitoxin 12,000 units.
July 1, 1:30 P. M.	22	99.8	20,050	77.25	15.50	6.75	0.25	0.25	N.	On 29th positive culture; coughed up pieces of membrane; antitoxin 12,000 units.
July 5, 12:30 P. M.	26	101.3	15,800	72.25	17.25	8.25	2.25	0	N.	July 8 died in fit of suffocation; autopsy showed ulcer in larynx, probably due to badly fitting tube.

CASE XXII.

DIAGNOSIS — MEASLES, DIPHTHERIA.

Male, age about twenty-five years. No history obtained, except that the rash appeared May 25.

Physical examination, May 26: Well developed and nourished. Marked conjunctivitis with photophobia; tonsils swollen and red, with mucus exudate; throat very red; macular rash on roof of mouth; numerous Kopliks; typical maculopapular rash on face and to a slight degree on the chest, not elsewhere. Heart negative; no râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 26, 4 P. M. . .	5 ±	101.5	4,400	81.00	12.75	5.00	1.25	0	—	Hg. 95%; red. 6,420,000.
May 29, 2:30 P.M.	8	103.8	5,000	89.75	7.00	3.00	0.25	0	—	Brilliant universal rash; severe conjunctivitis; enlarged and tender glands under jaw.
May 31, 12 M. . . .	10	100.5	8,100	62.25	24.50	9.25	4.00	0	—	Rash fading; petechæ in places; numerous dry râles; conjunctivitis better.
June 2, 5 P. M. . .	12	101.0	10,000	78.75	15.50	4.00	1.75	0	N.	Desquamation; throat red and inflamed; tonsils swollen, but without exudate.
June 5, 9 A. M. . .	15	100.3	15,700	85.00	8.75	6.25	0	0	N.	On 6th sore throat, hoarseness; temperature 101°.
June 7, 8:30 A.M.	17	99.0	14,200	87.75	7.75	4.00	0.50	0	N.	Very hoarse; no râles; tonsils red swollen, with thick exudate at mouth of crypts.
June 9, 9:30 A.M.	19	98.8	19,300	93.75	3.50	2.50	0.25	0	—	On 8th positive culture from throat; antitoxin 8,000 units on 7th and 8th.
June 12, 8 A. M. . .	22	99.3	10,300	90.50	3.75	3.75	1.25	0.75	..	Upon 14th; slight chronic pharyngitis; discharged well June 25.
June 17, 9 A. M. . .	27	98.5	9,700	73.50	19.50	5.25	1.25	0.50	+	

CASE XXIII.

DIAGNOSIS — MEASLES, DIPHTHERIA.

Female, age ten years. Pneumonia four years ago; no children's diseases. Present illness began June 10 with malaise, nausea, and headache; later, cough and sore eyes. Rash appeared on evening of June 14, on face and then on chest.

Physical examination, June 15: Well developed and nourished. Moderate prostration; slight conjunctivitis and coryza; a few Koplik spots on each cheek: characteristic early eruption of measles; thick on the face, thinner elsewhere. Heart negative: a few fine râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 15, 1 P. M...	5	101.0	4,400	83.25	12.25	3.50	0	1	—	Hg. 80%; crisis on 16th; mild case.
June 17, 8:30 A. M.	7	98.3	4,700	55.00	30.25	13.75	0.75	0.25	—	Rash fading; euphoria.
June 19, 9:30 A. M.	9	98.2	6,000	51.00	36.50	9.25	1.75	1.50	N.	Slight desquamation.
June 21, 12:30 P. M.	11	101.6	17,900	78.75	15.00	6.25	0	0	—	Sore throat; gray membrane on right tonsil, little on left; positive culture; antitoxin 8,000 units.
June 22, 3:30 P. M.	12	100.0	21,400	82.75	8.75	8.00	0.50	0	+	Comfortable.
June 25, 7 P. M...	15	98.5	14,500	59.25	26.50	8.50	3.75	2.00	..	Membrane rapidly disappeared.
June 28, 12:30 P. M.	18	100.3	19,900	80.50	14.25	3.50	1.75	0	N.	Urticaria; fever from antitoxin; increased leucocytosis and rise in neutrophiles, probably from same cause.
July 2, 5 P. M....	22	99.0	7,200	48.50	38.25	11.25	2.00	0	Sl.—	Digestive leucocytosis; discharged well July 8.
July 5, 3 P. M....	25	98.5	13,200	64.60	27.60	6.00	1.00	0.80	+	

CASE XXIV.

DIAGNOSIS — MEASLES, DIPHTHERIA

Male, age twenty-three years. Scarlatina, pertussis, and mumps in childhood. Malaria eleven years ago. Present disease began June 7 with fever, cough, hoarseness, and coryza. Two days later a rash appeared, first on the face, then on the body, with soreness of the eyes.

Physical examination, June 10: Well developed and nourished. Slight conjunctivitis; numerous Koplik spots; eruption on roof of mouth; characteristic blotchy eruption of measles on face and body. Soft systolic murmur at apex; scattered moist râles.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 10, 10:30 A.M.	4	104.2	5,100	84.75	6.75	8.25	0	0.25	—	Hg. 90%; urine—no albumin; cultures from nose and throat negative.
June 12, 8:30 A.M.	6	98.7	4,900	60.50	23.50	11.00	4.75	0.25	—	Brilliant eruption, confluent on face and mouth; negative culture.
June 14, 8:00 A.M.	8	98.8	12,600	74.00	21.00	4.50	0.50	0	—	Eruption gone except where it was petechial; voice hoarse.
June 17, 9:30 A.M.	11	98.2	21,000	83.25	6.00	10.25	0.25	0.25	+	Still hoarse; throat, heart, lungs, and abdomen negative.
June 19, 8:30 A.M.	13	99.0	29,800	85.25	7.75	6.75	0	0.25	N.	Chill yesterday with rise of temperature to 103.3°; nothing objective.
June 22, 12 M. . .	16	100.0	18,100	....	....	....	....	....	—	Does not appear sick.
June 25, 5:30 P.M.	19	99.0	15,600	....	....	....	....	....	..	Hoarseness wearing off; negative culture from nose and throat.
June 30, 3 P. M. . .	24	99.0	19,100	83.75	11.25	4.25	0.50	0.25	+	Discharged well June 30.

CASE XXV.

DIAGNOSIS—MEASLES DURING CONVALESCENCE FROM TYPHOID FEVER.

Male age sixteen years. Entered the Massachusetts General Hospital May 5, 1902, giving a history of two weeks of symptoms suggesting typhoid fever. On May 17, during convalescence from the fever, the temperature was accompanied by slight general symptoms, and on the third day a characteristic rash appeared.

Physical examination, May 20: Well-developed, moderately emaciated boy. Eyes suffused; numerous Koplik spots present; marked macular eruption on soft palate; typical eruption of macules and papules on face, trunk, and thighs, sparse on the legs, confluent on the back. Systolic murmur at apex; lungs negative; spleen not palpable, but enlarged to percussion.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 20, 4:30 P.M.	6 ±	101.5	3,400	65.25	29.50	3.50	1.75	0	N.	Red cells 4,336,000; Hg. 65%.
May 22, 4:30 P.M.	8	98.1	5,100	47.00	46.50	4.75	1.75	0	—	Temperature fell yesterday; rash nearly gone; desquamation beginning.
May, 24,	10	98.3	4,700	51.00	43.25	4.50	1.25	0	—	Convalescent.
May 27, 6 P.M. . .	13	97.8	5,500	62.00	30.50	5.75	1.50	0.25	N.	
May 31, 2 P.M. . .	17	98.5	5,200	60.75	33.00	5.25	0.75	0.25	Sl.—	Red cells show slight achromia Up on 5th.
June 6, 7 P.M. . . .	23	100.5	3,700	59.75	34.25	5.25	0.25	0.50	—	
June 11, 8:30 A.M. .	28	97.7	2,900	43.75	52.00	2.00	1.50	0.25	—	
June 18, 8 A.M. . .	35	98.5	4,500	58.50	31.50	8.25	1.25	0.50	—	Good convales- cence.
June 26, 10:30 A.M.	43	....	5,100	55.75	36.25	6.75	0.75	0.50	—	Discharged well July 2.

CASE XXVI.

DIAGNOSIS — SCARLATINA, MEASLES.

Female, age three years. No history obtained.

Physical examination, May 31: Fairly developed and nourished. Slight nasal discharge; mouth and throat red; papillae of tongue red and swollen; punctate eruption on roof of mouth and over chest and abdomen, emphasized in the groins and axillae, typical of scarlatina. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 31, 4 P. M...	2	101.8	9,300	67.75	21.25	7.75	3.00	0.25	+	Hg. 85%.
June 2, 4:30 P.M.	4	104.2	7,000	68.75	20.75	8.75	1.50	0.25	....	Characteristic maculopapular rash all over body; Koplik spots; 7 myelocytes.
June 4, 4 P. M...	6	99.3	12,300	58.50	34.00	4.25	3.25	0	—	Crisis; rash almost gone; no desquamation; conjunctivitis 3 myelocytes; moderate achromia.
June 6, 6:30 P.M.	8	98.1	19,600	58.25	33.75	5.00	2.75	0.25	+	Still much cough; 11 myelocytes.
June 8, 11:30 A.M.	10	98.4	19,200	48.25	41.25	7.50	2.75	0.25	N.	A few coarse rales, otherwise nothing objective; red cells normal; no myelocytes.
June 12, 3 P. M...	14	98.7	22,600	62.75	24.50	9.25	3.00	0.50	....	1 myelocyte.
June 16, 10:30 A.M.	18	98.7	16,600	57.00	33.75	5.50	3.00	0.75	N.	Typical desquamation of scarlatina.
June 21, 12 M...	23	98.4	13,600	39.25	49.50	7.75	1.75	1.75	Sl.—	Up yesterday; 1 myelocyte.
June 25, 6:30 P.M.	27	....	18,900	44.25	46.50	7.50	1.25	0.50	N.	Still desquimating.
June 29, 10 A. M.	31	....	14,400	52.50	34.00	9.50	3.75	0.25	N.	Discharged well July 21.
July 3, 2:30 P.M.	35	....	13,800	43.75	45.75	9.00	1.75	0.75	....

CASE XXVII.

DIAGNOSIS — SCARLATINA, MEASLES, OTITIS MEDIA.

Male, age seven years. Transferred from Eye and Ear Infirmary, where he had undergone an operation for adenoids. On May 29 he was seized with fever and malaise, and the next day a punctate erythematous eruption was noted. Entered the hospital May 31.

Physical examination, May 31: Well developed and nourished. Facies of adenoids; discharge from left ear; marked conjunctivitis and blepharitis; punctate eruption on roof of mouth; papillae of tongue, red and enlarged; throat red; over body a punctate erythema, fading on chest, bright on extremities. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
May 31, 3:30 P. M.	0	102.8	6,900	73.50	11.00	5.00	10.25	0.25	N.	Hg. 85%.
June 2, 3:30 P. M.	2	102	7,000	68.25	16.75	10.25	4.25	0.50	....	Rash fainter; eyes suffused; Koplik spots.
June 4, 6 P. M.	4	101.2	4,600	79.75	14.75	3.50	1.75	0.25	—	Typical maculopapular eruption on face, body, extremities, and hard palate; Koplik spots; cough.
June 5, 5 P. M.	5	100.1	4,500	71.75	23.00	3.25	1.25	0.75	N.	
June 7, 6:30 P. M.	7	100.4	4,600	60.25	24.25	10.25	5.25	0	—	On 6th rash profuse, confluent on body; temperature 103.2°.
June 9.....	9	100.3	9,100	72.25	20.75	5.00	1.75	0.25	—	Earache; no discharge; drum opaque.
June 12, 9 A. M.	12	99.9	11,700	69.25	16.75	7.25	6.25	0.50	N.	No symptoms; some achromia.
June 16, 10 A. M.	16	100.1	8,400	69.00	20.50	8.00	1.50	1.00	N.	Slight purulent discharge from both ears; partially deaf; chronic rhinitis and blepharitis.
June 21, 11 A. M.	21	98.4	10,300	61.75	24.75	9.25	2.50	1.75	—	Hg. 55%; red cells 4,248,000; reds show achromia.
June 29, 9 A. M.	27	....	7,800	48.50	37.00	11.00	3.25	0.25	+	Ear still discharging. August 1, discharged.

CASE XXVIII.

DIAGNOSIS — MEASLES, SCARLATINA DURING CONVALESCENCE.

Male, age five years. Past history negative. Present illness began June 10 with coryza; and rash appearing on the face.

Physical examination, June 10: Well developed and nourished. Suffusion of eyes; coryza; conspicuous Koplik spots; on the face is a discrete maculopapular eruption; a few spots on the chest, none elsewhere. Heart and lungs negative.

Date	Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells	Blood Plates	Remarks
June 10, 7 P. M..	4	103.1	7,800	76.00	18.25	4.75	0.25	0.75	N.	Hg. 80%; crisis on 12th.
June 12, 2 P. M..	6	99.5	5,800	49.75	33.75	12.50	4.00	0	—	Eruption, fully out yesterday, still bright to-day; condition good.
June 14, 8:30 A. M.	8	98.4	6,700	38.50	50.50	7.00	3.75	0.25	N.	Eruption fading away; occasional moist rale.
June 17, 10:30 A. M.	11	98.7	9,800	65.00	25.00	5.75	3.50	0.75	N.	Desquamation on 16th.
June 20, 8:30 A. M.	14	99.2	11,400	72.25	21.25	5.00	1.50	0	N.	Ear cold and cyanotic when blood taken; this might account for leucocytosis.
June 23, 8:30 A. M.	17	99.3	17,000	73.50	18.25	5.50	2.50	0.25	N.	
June 26, 9 A. M..	20	99.5	6,700	64.25	21.00	9.75	4.25	0.75	N.	No symptoms. Sore throat, fever, malaise; throat red, erythematous rash on neck and chest; scarlatina.
June 28, 4 P. M..	22	104.0	21,600	79.25	15.50	13.50	1.75	0	—	
June 30, 7:30 A. M.	24	99.2	25,600	89.75	4.75	4.00	1.25	0.25	—	Typical punctal erythema on body and roof of mouth yesterday; Hg. 65%; reds 4,644,000.
July 2, 3 P. M....	26	101.0	18,600	66.25	16.50	10.50	6.75	0	N.	Rash fading, but still present; desquamation.
July 5, 4 P. M....	29	99.8	19,300	59.75	29.00	6.25	4.50	0.50	N.	Euphoria. Discharged well August 20.

The subjoined table, based on fourteen cases in adults, will give an idea of the course of the white and differential counts, at different periods of the disease. It is, of course, not mathematically exact, being based on too few cases, for as the blood was not examined every day, some of the averages are made up from only

a few cases. It is obvious that cases running clinically a more rapid course will pass through the usual blood changes in a shorter time.

Day of Disease	Temperature	White Corpuscles	Polynuclear Leucocytes	Small Mononuclear Leucocytes	Large Mononuclear Leucocytes	Eosinophiles	Mast Cells
3	100.7	4,700	81.4	13.6	4.7	0.25	0
4	102.4	5,900	81.0	13.3	5.4	0.1	0.2
5	101.6	4,800	74.4	18.5	5.7	0.6	0.2
6	100.4	6,800	68.9	20.9	8.2	1.7	0.2
7	99.1	6,400	55.5	29.9	10.5	3.9	0.2
8	98.4	10,800	62.2	30.6	5.8	1.0	0.1
9	98.5	5,800	53.2	33.4	9.9	2.9	0.6
10	98.5	10,200	64.5	25.0	7.1	2.9	0.3
12	98.5	9,800	70.6	21.2	6.6	1.4	0.3
14	98.4	8,800	66.9	23.8	7.8	1.2	0.2

The following cases are of interest as showing the effect of complications:

Case XXIX. Diagnosis—measles, bronchopneumonia. Boy, age two years. Eighth day of disease. Rash appeared four days ago. Dyspnea, general bronchitis, well-marked consolidation at left upper lobe. Temperature, 100.8°. White count, 15,800. Differential count: neutrophiles, 57.50 per cent.; small lymphocytes, 31.50 per cent.; large lymphocytes, 5 per cent.; eosinophiles, 3.25 per cent.; mast cells, 0.25. 10 myelocytes. 1 megaloblast. Death on following day.

Case XXX. Diagnosis—measles, osteomyelitis. Girl, age eight years. Sixth day of disease. Fading rash. White count, 21,300. Neutrophiles, 80 per cent.; count rose to 42,700 later. Suppurating focus found at operation in upper epiphysis of tibia.

Case XXXI. Diagnosis—measles, parotitis epidemica. Boy, age eight years. Ninth day of disease. Rash nearly gone. Both parotoids swollen and painful. Temperature, 100.3°. White count, 16,800. Neutrophiles, 79.50 per cent.; small mononuclears, 9.75 per cent.; large mononuclears, 6.50 per cent.; eosinophiles, 4.25 per cent. Mast cells, 0.

Case XXXII. Diagnosis—measles, mastoiditis. Boy, age six years. Twenty-seventh day of measles, ninth day of mastoid disease. White count, 14,400. Operation the same day showed a small amount of pus in the mastoid.

Case XXXIII. Diagnosis—measles, severe conjunctivitis. Girl, age five years. Seventh day of disease. Eruption at its height. White count, 9,300. Neutrophiles, 87 per cent.

Let us first consider the white count. Unfortunately no cases could be examined during the period of incubation. In the latter part of the stage of invasion the count was normal, with the excep-

tion of Case XX, where a count of 16,700 was found on the day after the first symptoms appeared. The previous scarlatina renders this count of no value, as it is known that the leucocytosis of scarlatina may continue for weeks. The count fell with the breaking out of the rash, usually reaching its lowest point at the height of the rash. At this time it was usually a low normal; in one-third of the cases it was diminished below 5,000 (leucopenia); in a few cases it was normal. With the fall of temperature the count became normal, either immediately or within a few days, sometimes rising to slightly above normal. The extent of the diminution was in general not dependent upon the severity of the disease, except that the *very* low counts appeared only in severe cases. The average minimum count was 5,900, the lowest 2,500.

The neutrophiles followed a perfectly regular course; normal or somewhat increased during the period of invasion, they showed a well-marked relative increase in the stage of eruption, followed by a marked and sudden fall with the paling of the rash and the fall in temperature, reaching subnormal values. They then gradually increased to normal during convalescence. Neutrophilic myelocytes were found in ten cases, usually most abundant at the time of the crisis. They were more frequently found in children and always in small numbers, up to 1.25 per cent. The small lymphocytes followed a course opposite to that of the neutrophiles, being normal or already decreased in the period of invasion, markedly diminished during the eruption, rising to above normal at defervescence, and regaining normal values later. The large mononuclears (including large lymphocytes and transitional forms) were normal or even increased during the stage of eruption, and rose to above normal at defervescence. The eosins began to be diminished during the invasion, and at the height of the eruption were decreased or absent altogether. At defervescence they reached high normal values or were distinctly increased; in fact, they were in every case increased above the percentage normal for that individual. The highest percentage was 13.50 per cent. (Case XVI); two other cases (X and XVIII) showed 8 per cent.

The mast cells showed no characteristic changes. The blood

plates were usually markedly decreased at the height of the rash, but in several cases they were normal, and in one increased.

In the case of children there was likewise a normal or diminished white count during the eruptive stage, and the differential count underwent changes similar to that in the adult, if we reckon from the percentages normal for the age in question. As was to be expected, the neutrophiles were diminished and the lymphocytes and large mononuclears were increased as compared with measles in the adult. An infant, for example, showed during the eruptive stage an increase of neutrophiles up to 50 per cent.

The red count was normal during the acute stage, unless lowered by previous disease. In two cases in which several counts were made there was a moderate loss in red cells after the crisis, about 200,000. The hemaglobin showed no constant changes, but the method was not sufficiently accurate to detect slight variations.

COMPLICATIONS.

Acute otitis media occurred in four cases (XVI, XVII, XVIII, and XXVII), in three it caused leucocytosis, in all an increase in the neutrophiles. In two of these (XVII and XVIII) mastoiditis occurred later, and at operation the white and differential counts were practically normal, although pus was found. This shows us that in mastoiditis, as in appendicitis, the absence of leucocytosis rules out only a suppurating process which is in the acute stage. A third case of mastoiditis (XXXII) had a count of 14,400 on the ninth day; pus was found at operation. Bronchopneumonia in two cases (XXI and XXIX) was accompanied by leucocytosis. It probably accounted for the leucocytosis in Case XV, in which only the signs of extensive bronchitis could be detected. Scarlatina occurring simultaneously with measles in two cases (XXVI and XXVII) showed a normal white count, but increased eosins. This is interesting as showing how the two diseases interacted upon each other, measles abolishing the leucocytosis normal to scarlatina, and the latter increasing the eosins over the normal for measles. During convalescence the scarlatinal leucocytosis appeared in one case, but not in the other. Scarlatina complicating convalescence from measles (Case XXVIII) produced leuco-

cytosis with increased neutrophiles and eosins, as is usual in that disease. The complication with diphtheria (Cases XX-XXIII) always gave a well-marked leucocytosis. In two cases a rise in the neutrophiles or a failure to fall at the proper time preceded the rise in the white count, and came several days before the first symptoms of the disease. Measles during convalescence from typhoid showed a marked and long-continued leucopenia and increased lymphocytes; this was to be expected from the conjunction of the two diseases producing the same effects on the blood. Tonsilitis, parotitis epidemica, osteomyelitis, and subcutaneous abscesses (Cases XIX, XXXI, XXX, and V, respectively) were all accompanied by leucocytosis. Finally it must be mentioned that in four cases (II, VII, IX, and XII) there was a moderate leucocytosis (15,000) during convalescence, for which no cause could be found. This does not militate against the value of blood examinations; it merely shows that leucocytosis may sometimes arise from causes which our present clinical methods are not sufficiently delicate to detect.

It will be noticed that Sobotka, Renaud, and Plantenga have all found a leucocytosis during the incubation period of measles. This is of considerable theoretical interest, for it shows that during the time there is a reaction on the part of the organism toward the specific virus. It should also be of value in prophylaxis in hospitals, where frequent blood counts are possible. During the stage of eruption all observers have found either normal white counts or leucopenia. This puts measles in the same class with those acute infectious diseases which run their course without leucocytosis, typhoid, influenza, and miliary tuberculosis. The cause of leucopenia is to be sought either in the production of some substance exerting a negative chemotaxis on the leucocytes, so that they are sent out from the blood-making organs in diminished numbers, or in the actual destruction of leucocytes. The writer follows Türk in adopting the former view, as more in accord with the latest work on the chemistry of the blood. Diseases which of themselves produce leucocytosis do so also when complicating measles, as a rule, but during the stage of eruption the two diseases may counteract each other, so that a

normal count results. This occurred in my cases complicated with scarlatina. The presence, therefore, of leucocytosis points to a complication; its absence does not exclude one. It is worthy of note that the catarrhal processes belonging to measles do not, even if severe, cause leucocytosis, as shown by my cases of severe bronchitis, laryngitis, and conjunctivitis (Cases XVI and XXXIII). This is of diagnostic importance in distinguishing them from bronchopneumonia and diphtheria.

The studies of the course of the differential count made by Türk (three cases), Reckzeh (ten cases), and the writer (twenty-eight cases) agree in all essential particulars. The increase in neutrophiles with decreased eosins is not peculiar to measles, but occurs in practically all acute infectious diseases and in suppuration. Scarlatina alone shows an increase of both neutrophiles and eosins during the acute stage. The later increase of eosins in measles sometimes reaches the grade of that in scarlatina, but it is usually not so great and of much shorter duration. In those cases where the rash is of doubtful character, and it is hard to decide between measles and scarlatina, the blood may help us. Scarlatina is usually accompanied by a well-marked leucocytosis. Mild cases may have a normal count, but here the eosins are usually increased; in measles, on the contrary, they are diminished. The chief practical value of blood examinations in measles lies, in my opinion, in the early detection of complications, and here a rise in neutrophiles, even without leucocytosis, is suggestive. It is not often that the diagnosis is in doubt when the rash is already out.

CONCLUSIONS.

From my own work and that of others I would draw the following conclusions:

1. During the incubation period of measles a leucocytosis is present, which begins soon after infection, reaches its maximum six days before the appearance of the eruption, and lasts into the first part of the stage of invasion.
2. During the latter part of the stage of invasion and during the stage of eruption the white count is normal or more usually diminished, reaching its lowest point at the height of the rash.

3. The presence of leucocytosis points to the existence of a complication; its absence during the eruptive stage does not exclude one. The onset of leucocytosis with a complication may be preceded by a rise in the percentage of neutrophils, or a failure on their part to decrease at the proper time.

4. The differential count in measles takes the following definite course: the polynuclear neutrophils are increased during the stage of incubation, invasion, and eruption, fall below normal at defervescence, and reach normal in convalescence. Myelocytes are often present in small numbers during the period of eruption, especially in young children. The lymphocytes follow the opposite course—at first decreased, and increased after the crisis. The large mononuclear and transitional cells (including large lymphocytes) are normal at first, and increased later. Eosins are decreased or absent during the eruption, and later increased. The mast cells show no changes; the blood plates are usually decreased during the eruption. The blood becomes normal in all respects at about the twelfth day.

5. In doubtful cases the absence of leucocytosis with decreased eosins is in favor of the diagnosis of measles as against scarlatina, and *vice versa*.

6. The blood of measles in children shows the same changes as in adults, if the differences between the normal blood of children and that of adults be taken into consideration.

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